Comparison of Kansei Information between Joyful and Happy Expressions in Dance

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Abstract. This research was designed to investigate the relationships between Kansei information and movement characteristics in dance. The purpose is to specify the parameters contributing to the perception and identification of joy and happiness from dance movements. Professional and expert dancers expressed joy and happiness without using facial expressions. For capturing and recording expressions, we used a 3D motion capture system and digital video cameras. There were 54 observers who rated 50 items of Kansei information in both expressions. The results showed the scores of Kansei information for joyful expressions—happy, dynamic, energetic, strong, accelerated, decelerated, extended, high, asymmetrical, fast, accented, big, down, and sudden—were higher than those for happy expressions. We calculated acceleration for kinematic features, and the results showed that acceleration in joyful expressions was higher than in happy expressions. Our findings demonstrated the differences in strength of movements and emotions between joyful and happy expressions in dance.

1 Introduction

Previous studies of nonverbal expressions of feelings and emotions have examined various aspects of body movements. Observers have been found to be able to identify joy from gestures [1]. High levels of activity and large movements were perceived to express joy and anger in the performances of actors [2]. Previous studies tried to identify some emotions from valence and action level [3]. Moreover, for positive emotions, it is not clear which bodily movements should be associated with an emotion [4], and errors occurred more for the positive than for the negative emotions when observers identified actors' emotions [3].

Some dance studies focus on the relationship between audience perception and the movement characteristics of dance. A previous study [5] investigated the relationship between feelings and movement characteristics using three elements: time, energy,

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and design. Observers evaluated dance movements that expressed seven feelings and classified their interpretations based on the elements. Their results showed that expressions of happiness involve high speed, high energy, skipping, jumping, and turning, with many changes. In contrast, other studies [6] reported on emotionally expressive movements. The expression of joy was associated with many changes in the tempo of movements or extended movements from the center of the body. A study using kinematic data [7], [8] showed an association between three emotional expressions (joy, sadness, anger) and arm movement characteristics. This study found that three parameters of movement characteristics—speed, force, and directness—were useful for discriminating emotional expressions. Another study also showed a relationship between Kansei information and movement characteristics of the whole body by using motion capture [9], [10].

Although these previous studies have reported that body movements in dance have characteristics related to clear emotions which are not difficult to identify, it remains difficult to specify the distinctive parameters when using the whole body to convey similar expressions of feelings and ambiguous emotional expressions, particularly positive emotions. The purpose of this study is to specify the information and parameters that contribute to the perception and identification of joy and happiness from dance movements.

2 Methods

2.1 Dancers

Three dancers were asked to express joy and happiness through dance. One was a professional dancer, and the others were expert dancers, (a) and (b), with an average of six years of experience in varying forms of dance.

2.2 Procedure for Recordings to Joy and Happiness

Each dancer performed 3 different short dances to express joy and happiness. They were instructed to use their entire bodies. A total of 18 trials (2 expressions × 3 varieties × 3 dancers) were recorded. Each trial was performed twice and lasted for about 15 seconds. Before recording, they were allowed to practice for as long as they wished.

2.3 Apparatus

A video camera and 3D motion capture systems (Motion Analysis Corp., California) with 15 cameras were used to capture and record the dances. The sampling rate was 60 Hz. The acquired data were obtained as a time series of coordinate values (x, y, z) of each marker position in each frame. There were 32 reflective markers attached to the bodies of each dancer (Fig. 1).

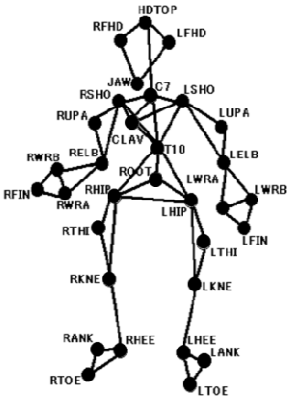

Fig. 1. Positions of markers

2.4 Displays for Evaluation

We used EvaRT software for motion capture data and created stick-figure displays from these data with 3D animation software Motion Builder 2012 (Autodesk Inc., California) for evaluation of the experiments.

2.5 Observers

A total of 54 observers who were university students (30 males and 24 females) participated in the evaluation. They were novices in dance, and their experience in this area consisted of viewing dance on television or dance training in physical education.

2.6 Evaluation

The 18 dance movements of the stick figures were presented in random order to the observers, and they completed a response sheet immediately after viewing a movement. The questionnaires for surveying expression and Kansei information are described in Table 1.

2.7 Items of Kansei Information

Observers were requested to watch the dances, and to rate words related to Kansei on a 5-point scale (*not expressive* (1) to *expressive* (5)). The words related to Kansei of dance included 36 items [11], and 14 items [12] were constructed based on the advice of the dancers.

3 Results

3.1 Comparison of Kansei Information between Joyful and Happy Expressions

To examine the differences in Kansei information between joyful and happy expressions, we conducted *t*-tests and compared means among joy and happiness responses for each Kansei information item.

The result is shown in Table 1. The squares in the table show that scores are more than 4.00, and there are significant differences between joy and happiness in the scores.

Scores of Kansei information for joyful expressions—happy, dynamic, energetic, strong, accelerated, decelerated, extend, high, asymmetrical, fast, accented, big, down,

and sudden—were higher than those for happy expressions. In addition, scores of Kansei information for happy expressions—flowing and smooth—were higher than those for joyful expressions.

Table 1. Comparison of mean scores of Kansei information between joyful and happy expressions

	Joyful expression		Happy expression		
Items	*mean*	(*SD*)	*mean*	(*SD*)	*p*
happy	4.51	(0.56)	4.00	(0.00)	*
lonely	2.00	(0.58)	1.14	(0.38)	**
sharp	2.57	(0.98)	1.57	(0.53)	*
solemn	3.00	(1.00)	3.43	(0.53)	
dynamic	4.57	(0.53)	4.00	(0.00)	*
flowing	4.00	(0.00)	4.57	(0.53)	*
usual	1.86	(0.90)	1.00	(1.00)	
pointed	2.00	(0.58)	1.43	(0.53)	
rounded	3.14	(1.21)	4.00	(0.00)	
dull	1.00	(0.00)	1.00	(0.00)	
energetic	4.57	(0.53)	4.00	(0.00)	*
depleted	1.00	(0.00)	1.29	(0.76)	*
strong	4.57	(0.53)	3.57	(0.53)	**
weak	1.86	(0.38)	2.00	(0.82)	
liner	4.00	(0.00)	3.43	(0.98)	
flat	1.29	(0.49)	1.29	(0.49)	
tense	1.57	(0.98)	1.86	(1.07)	
relaxed	1.57	(0.98)	1.57	(0.98)	
accelerated	4.83	(0.38)	4.14	(0.38)	**
decelerated	4.00	(0.82)	2.14	(1.21)	**
large	4.29	(0.49)	4.00	(0.00)	
narrow	1.43	(0.53)	1.43	(0.79)	
extended	4.29	(0.49)	4.00	(0.00)	*
flexed	2.86	(1.07)	1.43	(0.79)	
lateral	4.29	(0.49)	4.00	(0.00)	
vertical	4.29	(0.49)	4.00	(0.00)	
high	4.43	(0.53)	2.50	(0.84)	**
low	2.00	(1.29)	2.71	(1.38)	
regular	1.57	(0.79)	2.86	(0.38)	**
irregular	4.00	(0.00)	3.71	(0.49)	
equal	3.14	(0.38)	3.14	(0.38)	
unequal	2.71	(0.49)	3.00	(0.58)	
complex	3.86	(0.38)	3.71	(1.25)	
simple	1.43	(0.53)	1.29	(0.76)	
symmetrical	1.29	(0.82)	3.00	(1.00)	**

Table 1. (*continued*)

asymmetrical	4.00	(0.58)	2.00	(1.00)	**
fast	4.77	(0.53)	4.00	(0.00)	**
slow	2.00	(0.82)	2.41	(1.21)	
accented	4.14	(0.53)	2.00	(0.00)	**
smooth	3.58	(0.90)	4.43	(0.49)	*
big	4.29	(0.49)	3.14	(0.38)	**
small	1.43	(0.53)	1.43	(0.79)	
open	4.29	(0.49)	4.14	(0.38)	
closed	2.86	(1.07)	1.43	(0.79)	
up	4.29	(0.49)	4.00	(0.00)	
down	4.29	(0.49)	3.00	(0.00)	**
sudden	4.57	(0.53)	3.71	(0.49)	*
constant	1.57	(0.79)	2.86	(0.38)	*
steady	1.57	(0.53)	3.14	(0.38)	**
balanced	3.43	(0.53)	3.29	(0.76)	

* $p < 0.05$, ** $p < 0.01$

3.2 Comparison of Acceleration between Joyful and Happy Expressions

The results of 3.1 showed there are differences in Kansei information between joyful expressions and happy expressions. Because scores of Kansei information to joyful expressions—happy, dynamic, energetic, strong, accelerated, decelerated, extend, high, asymmetrical, fast, accented, big, down, sudden—were higher than those for happy expressions, we focused particularly on energetic, strong, accelerated, decelerated, fast, accented, and sudden. The information of energetic, strong, accelerated, and decelerated are related to dynamism [5], [12]. In addition, previous studies [7], [10], [13] have indicated that the relationship between the physical features of dance movements and their dynamism is driven by the velocity and acceleration of the bodies. We tried to find a relation between the dynamic elements of Kansei information for joyful expressions and happy expressions in these results and the acceleration as kinematic features. We compared the accelerations between joyful and happy expressions.

The acceleration was calculated from motion capture data. Because dance movements of 16 counts (8 counts × 2 times) take about 15 seconds, we determined the mean acceleration in 48 counts (16 counts × 3trials). The body parts used to calculate acceleration were the hip, right shoulder, and left shoulder (ROOT, RSHO, LSHO in Fig. 1). These parts are consisted as the body trunk which is important for moving in all kinds of dances. We compared the mean of each acceleration by the professional dancer and the expert dancers. We compared the acceleration between joyful and happy expressions using a *t*-test for each dancer. Table 2 shows the results for the professional dancer's acceleration, and Tables 3 and 4 show the results for the expert dancers' acceleration.

As shown by Table 2, there are no differences in acceleration between joyful and happy expressions in expert dancers' hip and both shoulders (hip: $t\ (94) = 1.48$, *n.s.*, right shoulder: $t\ (94) = 1.56$, *n.s.*, left shoulder: $t\ (94) = 1.12 =$ *n.s.*).

However in the expert dancers, there are significant differences between joyful and happy expressions (Tables 3 and 4). For expert (a), the mean scores for acceleration in joyful expressions were significantly higher than those in happy expressions for the hip, right shoulder, and left shoulder (hip: t (94) = 3.76, $p < 0.01$, right shoulder: t (94) = 3.40, $p < 0.01$, left shoulder: t (94) = 4.37, $p < 0.01$) Also, for expert (b), the mean scores for acceleration in joyful expressions were significantly higher than those in happy expressions for the hip and left shoulder (hip: t (94) = 2.39, $p < 0.05$, right shoulder: t (94) = 1.14, *n.s.*, left shoulder: t (94) = 2.12, $p < 0.05$). The expert dancers' results showed that scores for acceleration in joyful expressions was higher than in happy expressions, which indicated that joyful expressions have dynamic movement characteristics compared to happy expressions regardless of focusing on the body trunk not the limbs.

Table 2. Comparison of mean scores for acceleration between joyful and happy expressions by the professional dancer

	Professional dancer				
Acceleration (cm/s^2)	Joyful expression		Happy expression		
	Mean	(*SD*)	*mean*	(*SD*)	*p*
Hip (Root marker)	3.33	(2.32)	2.67	(2.13)	*n.s.*
Right shoulder	3.54	(3.67)	2.78	(2.10)	*n.s.*
Left shoulder	3.44	(3.76)	2.85	(2.22)	*n.s.*

Table 3. Comparison of mean scores for acceleration between joyful and happy expressions by expert dancer (a)

	Expert dancer (a)				
Acceleration (cm/s^2)	Joyful expression		Happy expression		
	Mean	(*SD*)	*mean*	(*SD*)	*p*
Hip (Root marker)	2.33	(1.67)	1.33	(0.91)	**
Right shoulder	2.44	(1.76)	1.43	(1.14)	**
Left shoulder	2.45	(1.67)	1.27	(0.90)	**

** $p < 0.01$

Table 4. Comparison of mean scores for acceleration between joyful and happy expressions by expert dancer (b)

	Expert dancer (b)				
Acceleration (cm/s^2)	Joyful expression		Happy expression		
	Mean	(*SD*)	*mean*	(*SD*)	*p*
Hip (Root marker)	2.41	(1.90)	1.66	(1.09)	*
Right shoulder	2.26	(1.55)	1.92	(1.25)	*n.s.*
Left shoulder	2.46	(1.82)	1.81	(1.12)	*

* $p < 0.05$

4 Discussion

This experiment sought to determine the parameters that contribute to perception and distinction of Kansei information between joy and happiness in dance expressions. We used a multivariate dataset of dance expressions and analyzed Kansei information and kinematic features. The results of *t*-tests for acceleration of the hip (root of body) and shoulders indicated that expressions of joy and happiness in dance each have a particular parameter.

Joyful expressions and happy expressions are both positive emotions, but we found that there are differences in the Kansei information. Kansei information for joyful expressions—happy, dynamic, energetic, strong, accelerated, decelerated, extended, high, asymmetrical, fast, accented, big, down, and sudden—were higher than those for happy expressions. Kansei information for happy expressions—flowing and smooth—were higher than those for joyful expressions. This indicated that joyful expressions have more strength, stimulus, or intensity than happy expressions. Because the degree of the happy item was stronger for joyful expressions, the score for the happy item may be higher for joyful expression. However, happy expressions do not instantaneously stimulate positive emotional expressions, but they may continuously stimulate constant positive emotional expressions.

We found that the difference of acceleration between expressions, and the acceleration for joyful expressions was higher than that for happy expressions. The acceleration is a kinematic feature indicating a movement's strength [7], [10], [13]. It was demonstrated that leg movements expressing anger were characterized by acceleration [8]. These previous studies convey information about strength and speed. In addition, we showed that joyful expressions have more strength than happy expressions.

We can express delicate differences when we show positive emotions. We can express emotions bodily and not just with facial expressions. Facial emotional expressions are identified basically as six emotions: happy, sad, angry, surprised, afraid, and disgusted [14]. Researchers have also tried to identify six bodily expressions of emotions: joy, sadness, anger, anxiety, pride, and contentment [3], and to discover how positive and negative emotions might change due to their range in valence and action level. Of course, it is difficult to identify emotions only from bodily information (without facial expressions). It is not clear how to discriminate positive emotions from a specific action [3], [4]. However, we found a difference between joyful expression and happy expression from the point of view of Kansei information through observer evaluations, although the expressions were focused on positive emotions and dance movements. In addition, we used motion data and observed differences in acceleration as kinematic features. The relation of Kansei information to kinematic features contributes to confusion in emotional perception and recognition of vague expressions. Moreover, our results encourage further research into addressing emotional expressions in dance, and in the creation and reproduction of vague emotional expressions using computer-generated (CG) animation, game characters, and humanoid robots.

Nevertheless, in the results for acceleration, there were no differences between joyful expressions and happy expressions in the data from the professional dancer. This reason may be that we were averaging the kinematic data. Because the standard

deviation of the acceleration of the professional dancer for all body parts was very large, this indicated that the professional dancer freely accelerated and decelerated his own body with breaks in his movements. Expressions by the professional dancer were specialized, meaning they were difficult to generalize. From an artistic point of view, it is necessary for professional dancers to show expressions which are different from those of other dancers. When investigating the expressions of professional dancers and artistic movements, we have to focus on different movements in each case and then analyze them. However, the expert dancers had the basics of movements and could do formulary expressions rather than free expressions. Particularly, novice dancers and dance students can use this expert dancer's results as an example of moving well and recognizing well. This research demonstrated that it is also important to move the body trunk, hips, and shoulders as a way to express differences between joy and happiness.

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